Gas Warfare.

Chemical Warfare. By Brig.-Gen. Amos A. Fries and Major C. J. West. Pp. xi+445. (New York and London: McGraw-Hill Book Co., Inc., 1921.)

IT is earnestly to be hoped that every British man of science will take the opportunity of studying this account of chemical warfare prepared by Brig.-Gen. Fries and Major West, of the United States Army. He will then be able to make up his mind, knowing the facts, as to the possibility of eliminating gas warfare by edict or mutual consent while war itself remains a possibility as before. Having answered this implied question, he must needs ask himself what is his own particular responsibility in the matter.

The need for propounding these questions is undoubted. Recent protests by certain eminent chemists, directed against the organisation of research for chemical warfare purposes, make it clear that considerable divergence of opinion exists as to the *rôle* which should be adopted by men of science in maintaining international peace. On one hand is the desire to withdraw all semblance of support from the perpetuation of what is regarded as a peculiarly inhumane method of waging war. On the other is the belief that, whatever we do, chemical warfare has come to stay; that peace and our national security will best be safeguarded by placing ourselves at least on an equality with our neighbours as regards the new warfare; and that, since, if we wish peace, we must be ready to fight for it, the man of science must shoulder his burden and prepare to become the military arbiter of the future. It is the old political battle of armaments transferred to the scientific arena.

In these circumstances, therefore, we are exceedingly fortunate in having the facts of chemical warfare placed before us so completely and clearly from an outside source. In Fries and West's book there is little of special pleading beyond that of military exigency. It supplies a full—indeed, a most astonishingly full—account of gas warfare in general, and, in particular, the part played by the United States in building up what was eventually the largest chemical warfare service of any of the belligerent nations.

It is highly significant, too, of the present position in America that the veil is withdrawn for the first time from many of the most carefully guarded chemical warfare secrets of the past. For example, a whole chapter is devoted to the thermal production of particulate clouds. Side by side with these frank disclosures are the following statements—the first, in the foreword, by Major-Gen. W. S. Sibert, General Fries's distinguished predecessor as Chief of the Chemical Warfare Service in America; the other in the body of the book:—

> "There is no field in which the future possibilities are greater than in chemical warfare, and no field in which neglect to keep abreast of the times in research and training would be more disastrous."
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> "Poison gas in the World War proved to be one of the most powerful of all weapons of war. For that reason alone it will never be abandoned. It cannot be stopped by agreement. . . ."

From the considered inclusion of such opinions in a book redolent with disclosure only one conclusion can be drawn.

The United States Chemical Warfare Service was built up almost wholly on the foundations of British practice and experience. To this fact and to the subsequent intimate relations between the two services Fries and West pay generous tribute. As to the magnitude of the American organisation, its success in every branch and its clear-sighted vision, facts are allowed to speak for themselves. Owing to the cessation of hostilities the full extent of the American chemists' great effort was probably never generally realised in England, and only partially, perhaps, even in the inner circles of the War Office and the Ministry of Munitions. Yet it was unquestionably one of the greatest achievements of the war. Starting literally from nothing, the Americans within nine months elaborated a service in which research, manufacture, training, and field organisation were brought to the highest pitch of efficiency. In Washington the research department under Burrell mustered a chemical *personnel* of 1200, which included men of international reputation such as Wilder Bancroft, Hulett, W. K. Lewis, and Tolman. It is small wonder, therefore, that some very fine work was accomplished.

It is, however, by a consideration of Edgewood Arsenal that the full extent of the American chemical warfare effort can best be gauged. Built on an isolated tract of country in Maryland, this poison-gas factory attained a magnitude which is simply staggering. By October, 1918, it employed 10,247 men, and was successfully making chloropicrin, phosgene, mustard gas, bromobenzylcyanide, and other accessory chemicals, and was in a position to turn out 100 tons of liquefied chlorine a day. As a feat of chemical engineering alone it must be almost unique. As an indication of what can be accomplished without recourse to

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existing plant it gives one food for considerable thought.

The success of Edgewood Arsenal and the gas mask factories was due in no small measure to the inauguration of a development division intermediate between the Research Department and the manufacturing plants. The difficulties attending large-scale production were overcome in the single-unit plants of the development section, and the results obtained immediately transferred to Edgewood and the subsidiary factories spread up and down the country. Only in this way was it possible to maintain throughput at its maximum and avoid the time- and labour-consuming hindrances notoriously attendant on the alteration of existing plant or the installation of new. It is a procedure heartily to be commended to many of our own industrial concerns, where much good research is wasted by inability of the works to cope with difficulties which could well be overcome by experimentation on full-sized units.

Of course, even in America, the enormous chemical warfare organisation did not come into being without attendant inefficiencies. General Fries points out the difficulties he encountered in having his cabled demands from the Expeditionary Force attended to (did he but know it, he was no worse off in this way than the British, who were fighting almost at their own door). This was due to a lack of co-ordination between the numerous extensive divisions of the service, each of which had grown up separately. Eventually a Chief of the Chemical Warfare Service was appointed, but in the interim the various separate activities were held together only by the personal efforts of William H. Walker, of the Massachusetts Institute of Technology. General Fries and Major West are not sufficiently appreciative of Walker's efforts during this disquieting period. In service to his country Walker accomplished in this unofficial co-ordination something even greater than his subsequent organisation and control of Edgewood Arsenal. Without him General Fries and the American Expeditionary Force would have had to remain dependent for supplies on Britain for many months longer than they did.

The book is full of information of a technical nature previously denied to the average man of science, and even without its clarity and illuminating illustrations would hold the reader enthralled from start to finish. It is a fine compilation and a great tribute to American chemists. Its publication can do nothing but good in throwing light on a subject of ever-increasing international importance. Its extensive sections, dealing with the legitimacy of gas warfare and its possibilities in the future, are highly stimulating, but must be read in conjunction with the remainder properly to be appreciated. Sufficient has been quoted above to indicate the authors' views on the subject.

No British notice of "Chemical Warfare" would be complete without reference to the now notorious "Lewisite." Whatever the British views as to the war value of chlorovinyldichloroarsine, the fact remains that the Americans rated, and still rate, it very highly indeed. It was under the strictest pledges of official secrecy that its nature and mode of preparation were imparted to the British Government. It is therefore most disquieting to find it made the subject of a communication to a scientific society without express permission being obtained from the real owners of the secret. As the communication was sanctioned by the War Office, there would appear to be two explanations required—one from the military authorities, and the other from the authors of the paper referred to. Doubtless some satisfactory explanation can be given of this "unfortunate, or otherwise" (Fries and West), occurrence, but the Official Secrets Act, our friendly relations with foreign Governments, and respected procedure regarding scientific publication, all appear to be involved.

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Zoology for Medical Students.

Zoology for Medical Students. By Prof. J. Graham Kerr. Pp. x+485. (London: Macmillan and Co., Ltd., 1921.) 25*s.* net.

SUCH a title challenges attention not merely as a scientific work but as a confession of faith. It is the *credo* of one of our younger men on education at this moment when there is nothing else of such importance. A huge and undigested heap of students has been shovelled into our universities by the combined pressure of war arrears and Government subsidies (8,000,000*l.* sterling is to be spent first and last by the Treasury alone on University courses for ex-officers). These men are our inevitable masters in the decade to come. Thus vital are the principles on which Prof. Graham Kerr decides to cultivate his garden.

The professor of zoology in Scotland has a dreadful task. In ten short weeks he has to expound and classify all the innumerable combinations of living matter. In addition he has to break in to the life of a university a class of many scores—sometimes of hundreds—of last year's secondary schoolboys. The biology of the first-year medical student has to unfold its

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